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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/123,352	07/28/98	LI Y	100869

OLIFF & BERRIDGE
P O BOX 19928
ALEXANDRIA VA 22320

IM61/0329

EXAMINER
ZERVIGON,R

ART UNIT	PAPER NUMBER
1763	

DATE MAILED: 03/29/99

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

PTO-90C (Rev. 2/95)

U S GPO 1998-437-638/80022

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Office Action Summary

Application No.	Applicant(s)
09/123,352	Yunlong et al
Examiner	**Group Art Unit**
Rudy Zervigon	1763

Responsive to communication(s) filed on ______.

This action is **FINAL**.

Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

X Claim(s) *1-16* is/are pending in the application.

Of the above, claim(s) ______ is/are withdrawn from consideration.

Claim(s) ______ is/are allowed.

X Claim(s) *1-16* is/are rejected.

Claim(s) ______ is/are objected to.

Claims ______ are subject to restriction or election requirement.

Application Papers

X See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

The drawing(s) filed on ______ is/are objected to by the Examiner.

The proposed drawing correction, filed on ______ is approved disapproved.

The specification is objected to by the Examiner.

The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

X Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

X All Some* None of the CERTIFIED copies of the priority documents have been

X received.

received in Application No. (Series Code/Serial Number) ______.

received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: ______

Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

X Notice of References Cited, PTO-892

Information Disclosure Statement(s), PTO-1449, Paper No(s). ______

Interview Summary, PTO-413

X Notice of Draftsperson's Patent Drawing Review, PTO-948

Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1,2,4, and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kisakibaru et al in view of Misuzu Watanabe, Nakayama et al, and Saito et al. Kisakibaru et al describe a plasma treatment apparatus allowing the plasma density to be controlled by magnetic line formation means. Specifically, Kisakibaru et al detail a *plasma generation apparatus (Figure 9)* containing a *vacuum vessel* embodied as a *cylindrical* treatment chamber (item 1, Figures 8,9; column 7, lines 1-10) with a *plasma generation region in the interior thereof* (item 6, Figures 8,9; column 7, line 11). The plasma generation apparatus discussed by Kisakibaru et al also contains *gas induction means* embodied as electrodes 7a and 7b of Figure 9 (column 7, lines 11-18) *for inducting discharge gas into the interior of the* Kisakibaru et al *vacuum vessel.* Electrode 7b is seen to function in the claim 6 limitation of *a wall used as a holder for holding objects to be treated (Figure 9).* In Kisakibaru et al example the object to be treated is seen to be item 4, Figure 9. Kisakibaru et al also discuss *magnetic force line formation means for forming magnetic force lines having portions roughly parallel to the center axis of the cylindrical discharge electrode such that the length of the*

force lines become longer closer to the center axis. Kisakibaru et al 's *magnetic force line formation means for forming magnetic force lines having portions roughly parallel to the center axis of the cylindrical discharge electrode such that the length of the force lines become longer closer to the center axis* is embodied according to a prior art discussion detailed in column 2, lines 46-49 and shown in Figure 3 of the Kisakibaru et al patent. Kisakibaru et al identifies this design as the "longitudinal magnetic field method". Additionally, Kisakibaru et al describe one of two electrodes, specifically electrode 7b (Figure 9) as connected to a *reference potential point* namely ground in this embodiment.

Saito et al discuss a plasma processing apparatus for processing or forming a thin film on a substrate within a vacuum vessel (abstract). Saito et al also refers to the Kisakibaru et al Figure 3 design as a "cusped magnetic field" arrangement (Figure 9, Saito et al). Saito et al's cusped magnetic field discussion is centered on Figure 9 (column 11, lines 40-60). In addition Saito et al describes *position adjustment means for adjusting positions of a wall electrode in the dimension of the center axis of* Saito et al's plasma reactor. Kisakibaru et al does explicitly discuss *magnetic force lines shaped so that they do not intersect the two walls* as *electrically conducting* electrodes (column 7, line 12) which enclose the generated plasma according to column 5, lines 33-49 (Figure 7). The Kisakibaru et al do not explicitly discuss *exhaust means for exhausting the atmosphere in the interior of the plasma vacuum vessel.* Misuzu Watanabe describes a carbon film producing method utilizing a *plasma* generation apparatus process for projecting carbon particles from a graphite target electrode

to deposit a very thin layer on a substrate (abstract). Misuzu Watanabe also describes the establishment of two *electrically conducting walls* that *sandwich* the plasma generation region **A** between the first *electrically conductive* wall **anode or opposite** wall **electrode 46, which is secured and *grounded* through a *conductive* rod 48 to the upper cover 14, and the** *second wall* **graphite target electrode 44 that is positioned in a parallel-spaced relation to the** first *electrically conductive* wall **anode or opposite** wall **electrode 46.** Misuzu Watanabe (DETD(2)) discusses exhaust means according to the lower cover 16 which is formed centrally with an opening through which an *exhaust* pipe 24 opens into the *vacuum vessel* for *exhausting the atmosphere in the interior of the vacuum vessel*. The *exhaust* pipe 24 is connected to a vacuum pump (not shown) which is operable to evacuate the *vacuum vessel* and keep it at a high vacuum. Kisakibaru et al do not explicitly discuss *a cylindrical discharge electrode with applied high-frequency electric power that encloses the plasma generation region.* Muneo Nakayama et al describe a method of forming silicone film using the apparatus shown in figures 1 and 2 of U.S. Pat. 4,894,254. Specifically, from DETD(91), the plasma treatment apparatus 100 has an *outer cylindrical discharge electrode* 103 fitted over a chamber member 2 *so as to enclose the plasma generation region S2 (Figure 2)* and an inner cylindrical electrode 104 disposed in the chamber member 2 in concentric relation to the *cylindrical discharge electrode 103*.

Kisakibaru et al additionally meet the claim 1 limitation of *two walls positioned so as to sandwich the plasma generation region between them in dimension of a center axis electrode* according to electrodes 7a and 7b of Figure 9 (column 7, lines 11-18).

With the foundation provided by Kisakibaru et al in view of the teachings of Misuzu Watanabe, Nakayama et al, and Saito et al., a person of ordinary skill in the art at the time the invention was made would find the enhancements and/or design variations discussed by Misuzu Watanabe, Nakayama et al, and Saito et al, to be obvious enhancements over Kisakibaru et al's a plasma treatment apparatus. Motivation for the enhancements to the Kisakibaru et al's plasma treatment apparatus center on a theme common to the art of plasma apparatus design, namely controlling or influencing plasma attributes lending to higher plasma densities and uniformity local to the processed substrate. These motivations are additionally consistent with the inventor's motivations relied upon for rejections on the present claims.

3. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kisakibaru et al as applied to claims 1,2,4, and 6 above, and further in view of Asamaki et al. Asamaki et al discuss a plasma processing apparatus that is designed to increase processing speeds and reduce the temperature stress applied to substrates (abstract). The Asamaki et al inventors describe a plasma processing apparatus that meets the claim 3 limitation of an additional *high-frequency electric power application means* and contains both a cathode power source and an anode power source according to the following excerpt from column 2:

vessel 10 as shown by an arrow 13. A processing system 20 in the vacuum vessel 10 comprises a cathode 21 and an anode 22 and a cathode power source 23 and an anode power source 24 for causing discharge between the cathode and anode and controlling the discharge.

With the Kisakibaru et al's plasma treatment apparatus as a foundation, one of ordinary skill in the art would consider an additional power source applied to a counter electrode (as detailed by Kisakibaru et al's plasma treatment apparatus) as an obvious enhancement over Kisakibaru et al's plasma treatment apparatus. Motivation for implementing another power source applied to a counter electrode is again centered around the common motivation to control plasma geometry and density. Additional motivation for an additional power source applied to a counter electrode is provided by Asamaki et al.

4. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kisakibaru et al as applied to claims 1,2,3 and 6 above, and further in view of Hisaharu Obinata. Hisaharu Obinata describes a sputter etching apparatus having a second electrically floating electrode and magnet means (title). Specifically, from DETD(19), an opposite electrode is provided in an electrically floating condition and face a sputter etching electrode so that a plasma generated in a space between the two

electrodes can be prevented from being diffused forwards. Magnet means for establishing a magnetic field for is additionally disclosed for confining the plasma in the space by surrounding the same, so that the plasma can be further prevented from being diffused and, as a result, the etching rate can be more improved. With the Kisakibaru et al apparatus as a footing, a person of ordinary skill in the art at the time the invention was made would consider the Hisaharu Obinata floating electrode to be an obvious enhancement over the Kisakibaru et al apparatus with the motivation provided by Hisaharu Obinata, and consistent with motivations presented thus far.

5. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kisakibaru et al as applied to claims 1,2 and 3 above, and further in view of Nakayama et al. Muneo Nakayama et al describe a method of forming silicone film using the apparatus shown in figures 1 and 2 of U.S. Pat. 4,894,254. Specifically, from DETD(91), the plasma treatment apparatus 100 has an *outer cylindrical discharge electrode* 103 fitted over a chamber member 2 *so as to enclose the plasma generation region S2 (Figure 2)* and an inner cylindrical electrode 104 disposed in the chamber member 2 in concentric relation to the *cylindrical discharge electrode 103*. The *cylindrical discharge electrode 103* is electrically connected to a *first high-frequency power supply means for applying high-frequency electric power*, and the electrode 104 is grounded. The electrode 104 is in the form of a hollow cylinder with open upper and lower ends and has a plurality of small through holes 104a. The electrodes 103, 104 serve to generate a plasma in the apparatus 100. A person of ordinary skill in the art at the time the invention was made would find Muneo Nakayama et al's *outer cylindrical discharge electrode* 103 as an obvious enhancement of Kisakibaru et al's plasma treatment apparatus.

Motivation for applying a radio frequency power to Kisakibaru et al's *cylindrical treatment chamber* (item 1, Figures 8,9; column 7, lines 1-10) stems from the desire to localize and control the plasma region geometry and density.

6. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kisakibaru et al as applied to claims 1,2 and 3 above, and further in view of Hans Oechsner and Nakayama et al. Hans Oechsner describes a high frequency ion source using electron cyclotron resonance. Specifically, Hans Oechsner describes a vessel capable of housing an ionizable gas which is surrounded by a coil. The coil is coupled to a high-frequency *power supply* generator *for outputting high-frequency electric power applied to a* coil electrode via a *high-frequency resonant circuit for resonating with the high-frequency electric power output from the high-frequency electric power supply*. Hans Oechsner additionally describes *control means for controlling the magnitude of the high frequency electric power output from the high frequency electric power supply*. Specifically, Hans Oechsner embodies the *control means for controlling the magnitude of the high frequency electric power output from the high frequency electric power supply* according to the following excerpt from column 4:

The electron cyclotron frequency $\omega_{c,e}$ constitutes an accumulation point for the respective resonant frequencies ω_z ($z=0, 1, 2 \ldots$) where $\omega_z < \omega_{c,e}$. This means that, at an excitation frequency ω set by the high-frequency generator, electron cyclotron wave resonance of a specific order z can be established by appropriate selection of the magnitude of the superimposed d.c. magnetic field B_0 which, in turn, determines $\omega_{c,e}$. In practice, excitation at the fundamental resonance ω_0 or the first upper resonance ω_1 are of significance.

Hans Oechsner does not reproduce the geometry of the applicant's annular discharge electrode. Muneo Nakayama et al describe a method of forming silicone film using the apparatus shown in figures 1 and 2 of U.S. Pat. 4,894,254. Specifically, from DETD(91), the plasma treatment apparatus 100 has an *outer cylindrical discharge electrode* 103 fitted over a chamber member 2 *so as to enclose the plasma generation region S2 (Figure 2)* and an inner cylindrical electrode 104 disposed in the chamber member 2 in concentric relation to the *cylindrical discharge electrode 103*. The *cylindrical discharge electrode 103* is electrically connected to a *first high-frequency power supply means for applying high-frequency electric power*, and the electrode 104 is grounded. The electrode 104 is in the form of a hollow cylinder with open upper and lower ends and has a plurality

of small through holes 104a. The electrodes 103, 104 serve to generate a plasma in the apparatus 100. A person of ordinary skill in the art at the time the invention was made would consider Hans Oechsner's high frequency ion source using a coil that is coupled to a high-frequency *power supply* generator *for outputting high-frequency electric power applied to a* coil electrode via a *high-frequency resonant circuit for resonating with the high-frequency electric power output from the high-frequency electric power supply* to be an obvious extension of Nakayama et al's plasma treatment apparatus' *high-frequency electric power output* as applied to Nakayama et al's *outer cylindrical discharge electrode*. Motivation for combining the above references and for applying Hans Oechsner's *high-frequency resonant circuit for resonating with the high-frequency electric power output from the high-frequency electric power supply* to Nakayama et al's *outer cylindrical discharge electrode* stems from the desire to localize and control the plasma region geometry and density as promoted by the references used in this rejection.

7. Claims 9-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kisakibaru as applied to claims 1,2,4, and 6 above, and further in view of Kinoshita et al. Kinoshita et al describe a chemical vapor deposition apparatus utilizing a magnetron discharge contained within a plurality of electrodes (column 1, lines 9-15). Specifically, from DETD(4), Kinoshita et al make reference to the first embodiment of the invention as shown in Figure 3. Figure 3 shows a plasma apparatus comprising *first electrode wall 1 (21)* and *second electrode wall 2 (22)* arranged parallel to each other in chamber 1. *First electrode wall 1 (21)* is *connected to a reference potential point* shown as one

terminal of an AC, high frequency or RF power source 6 through blocking capacitor 7 and *second electrode wall 2 (22) connected to the same reference potential point* terminal of high frequency power source 6 through blocking capacitor 7. A wire connecting *first electrode wall 1 (21)* with one terminal of high frequency power source 6 through blocking capacitor 7 and a wire connecting *second electrode wall 2 (22)* with the other terminal of high frequency power source 6 through the blocking capacitor 7 are insulated from chamber 1 by insulator 9, 9, respectively. A pair of three-piece sets of solenoids 12 are arranged outside chamber 1 surrounding the first and the second electrodes 21, 22 in an orientation such that magnetic field lines 11 are parallel to first and second electrodes 21, 22. None of the references used in the rejection of claims 1,2,4, and 6 above teach *control means for controlling the magnitude of high frequency electric power* as applied to the applicant's annular discharge electrode. However, Kinoshita et al teach intricate *control means for controlling the magnitude of high frequency electric power* of a multitude of dependent and independent plasma electrodes as discussed above. In another embodiment detailed by Kinoshita et al (DETD(25), Figure 6) electric power Ph1 and Ph2 of *high frequency power sources* 16, 26 are supplied to *first and second wall electrodes* 21, 22 at an arbitrary phase difference and an *arbitrary power supply ratio* through blocking capacitor 7. Motivation for this design is so that a part of the light electrons in the plasma run into *first wall electrode (21)* and into *second wall electrode (22)*, which is stored in blocking capacitors 7 so that a negative self-bias voltage is generated. Ion sheaths in which positive ion densities are higher are generated in the neighborhood of *first wall electrode (21)* and *second wall electrode (22)* with the generation of the negative self-bias voltage. In the ion

sheath section, there are positive ions having high densities. The ion sheath section increases so that strong electric fields are applied in a direction perpendicular to the *first and second wall electrodes* 21, 22. A person of ordinary skill in the art at the time the invention was made would consider Kinoshita et al's reference potential points to be an obvious extension over the combined references of Kisakibaru as applied to claims 1,2,4, and 6 above. Motivation for combining the above references is again centered on providing plasma density and geometry control which are conducive to isotropic etching. The references sited in this claim rejection provide additional motivation for each respective design criteria.

8. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kisakibaru et al as applied to claim 8 above, and further in view of Smesny et al and Saito et al. Smesny et al describes an integrated circuit dry etch chamber (item 90, Figure 5; column 12, lines 11-28). Specifically, Smesny et al describe a *position adjustment means for adjusting positions of* a movable first *electrically conductive* wall **electrode** (item 92, Figure 5; column 12, line 15). In addition, DETD(22), Figure 5 shows an integrated circuit dry etching chamber 90. A chamber 90 preferably includes a movable upper *first electrically conductive wall* ***electrode*** 92 and a stationary *second wall* ***electrode*** *94*. Upper *first electrically conductive wall* ***electrode*** *92* is connected to a power supply, preferably at ground potential, whereas *second wall* ***electrode*** *94* is preferably coupled to an RF supply. A reactive gas etch material is inserted through a port (not shown) between upper and lower electrodes 92 and 94, respectively. In addition, DETD(23), the position and movement of upper *first*

electrically conductive wall ***electrode*** *92* is controlled and monitored in part by one or more motors 96 and linear encoders 98. Also, DETD(24), Linear encoders 98 determine the relative position of upper *first electrically conductive wall* ***electrode*** *92* based upon a known position of lower electrode 96. Thus, relative position of the electrodes can be obtained using such an encoder technique. The relative positions of upper *first electrically conductive wall* ***electrode*** *92* with respect to *second wall* ***electrode*** *94* must be periodically calibrated in order to ensure proper gap distance between the electrodes. Unfortunately, calibration between electrodes does not ensure calibration between wafer 10 upper surface and upper *first electrically conductive wall* ***electrode*** *92*, as is necessary for measuring and achieving more precise etching conditions. As upper *first electrically conductive wall* ***electrode*** *92* is moved up or down by rotating nut 100 and cam screw 102. Accurate distances between upper *first electrically conductive wall* ***electrode*** *92* and wafer 10 upper surface are optimally achieved using opto-electric, acoustic, etc., non-contact displacement sensors placed upon the upper surface. . . light emitting diode (LED) 104, and associated lens, provides suitable light energy directed upon the lower surface of upper *first electrically conductive wall* ***electrode*** *92*. Light energy reflects from the lower surface of upper *first electrically conductive wall* ***electrode*** *92* and back upon the upper surface of wafer 10. If upper *first electrically conductive wall* ***electrode*** *92* is at a proper distance, calibrated distance, from wafer 10, then a specified amount of reflected light will strike a photodiode sensor 106 formed upon wafer 10 and spaced from LED 104. In addition, DETD(25), wafer 10 can determine whether or not *first electrically conductive wall* ***electrode*** *92* is in its calibrated position based upon whether or not photodiode 106 receives a specified amount of

reflected light. If upper electrode is in its calibrated position, then subsequently introduced standard wafers and *first electrically conductive wall* ***electrode*** *92* can be moved about its calibrated position leaving the operator fully aware of *first electrically conductive wall* ***electrode*** *92* position with respect to the ensuing wafer topography. Accordingly, wafer 10 and associated sensors 104 and 106 provide proper calibration. . .electrodes, and also provide information to the operator about the relative distance between wafer 10 upper surface and upper electrode 92 lower surface if *first electrically conductive wall* ***electrode*** *92* should ever change position through the activation of motors 96 and encoder 98. Smesny et al however does not specifically describe a movable *second wall* **electrode.** Saito et al, as described above, additionally describes *position adjustment means for adjusting positions of* a movable *second wall* **electrode** *in the dimension of the center axis of* Saito et al's plasma reactor. a person of ordinary skill in the art at the time the invention was made would consider the enhancements by Smesny et al and Saito et al over Kisakibaru et al as applied to claim 8 above to be obvious. Motivation for combining the above references centers on the common objective to control plasma density and geometry attributes. The positioning of the upper and lower wall electrodes further confines and alters the plasma surface contour which is consistent with plasma density control and manipulation.

9. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kisakibaru et al as applied to claims 1,2,4, and 6 above, and further in view of Inazawa et al. The refereces used in this rejection, other than Inazawa et al, do not describe the specifics of claim 15. Inazawa et al describe a plasma processing apparatus that is designed to increase the etching selection ratio. In addition,

BSUM(16),Inazawa et al provides a plasma etching method in which a processing gas is introduced into a processing room housing a substrate, an RF power is applied across opposite electrodes to cause the processing gas to discharge, thereby generating a plasma, and a first layer supported by the substrate is etched by using the plasma in preference to a second layer supported by the substrate and consisting of a material different from that of the. Specifically, DETD(9), the ceiling portion of the processing chamber 16 is defined by an *upper first electrically conductive wall electrode* 40. a portion between the side wall and ceiling portion of the processing chamber 16 are sealed by a seal member 41 constituted by, e.g., an O-ring. The *upper first electrically conductive wall electrode* 40, the side wall of the processing chamber 16, and the exhaust ring 25 are grounded. Therefore, when an RF power. . . an RF electric field in the processing room 14a, the *second wall electrode 24* functions as a cathode electrode, and the members 40, 16, and 25 function as an anode electrode. In addition, the *second wall electrode 24 is used as a holder for holding objects (Item W, Figure 1) to be treated (see Figure 1).* In addition, DETD(10), the *upper first electrically conductive wall electrode* 40 consists of a conductive material such as amorphous carbon, SiC, or Al. The *upper first electrically conductive wall electrode* 40 has a shower head structure *gas diffusion plate*. More specifically, the *upper first electrically conductive wall electrode* 40 has a hollow interior, and a large number of *gas diffusion holes* 42 are formed in its entire surface opposite to the wafer W. a dispensing plate (not shown) is disposed in the *upper first electrically conductive wall electrode* 40. An etching gas fed into the *upper first electrically conductive wall electrode* 40 through a gas feed pipe 44 is uniformly sprayed into the processing chamber 16 through the gas diffusion holes 42. a

person of ordinary skill in the art at the time the invention was made would consider the teachings of Inazawa et al to be an obvious improvement over the Kisakibaru et al plasma reactor. Motivation for combining the above references is drawn from the added advantage of evenly distributing the process gas introduced into the process chamber over the entire length of the reactor volume as is commonly accomplished when using shower head gas distributors

10. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Misuzu Watanabe in view of Nakayama et al. Misuzu Watanabe describes a carbon film producing method utilizing a *plasma* generation apparatus process for projecting carbon particles from a graphite target electrode to deposit a very thin layer on a substrate (abstract). Specifically, DETD(2), the sputtering device (shown in Figure 1) includes a *vacuum vessel*, designated generally by the numeral 10, which includes a *cylindrical metal body* 12 closed at its opposite ends with upper and lower metal covers 14 and 16 to define a *vacuum vessel* therein *enclosing the plasma generation region a*. An O-ring 20 is provided to prevent leakage between the upper cover 14 and the cylindrical body upper end. Similarly, an O-ring 22 is provided to prevent leakage between the lower cover 16 and the cylindrical body lower end. The lower cover 16 is formed centrally with an opening through which an *exhaust* pipe 24 opens into the *vacuum vessel* for *exhausting the atmosphere in the interior of the vacuum vessel*. The *exhaust* pipe 24 is connected to a vacuum pump (not shown) which is operable to evacuate the *vacuum vessel* and keep it at a high vacuum. a gas mixture is introduced through a gas

inlet pipe 26 to provide an atmosphere of the gas mixture in the *vacuum vessel*. The gas inlet pipe 26 extends through the cylindrical body wall at a position near the upper cover 14.

In addition, DETD(3), a coolant pipe 30 extends through the cylindrical body 12 into the *vacuum vessel* and terminates in an upward facing flange 32 on which an electrode box 40 is placed. a seal is provided to prevent leakage between the coolant pipe 30 and the cylindrical body wall. The electrode box 40 has a magnetron 42 including a permanent magnet placed therein and a graphite target or cathode electrode 44 supported thereon. *Magnetic force line forming means* detailed in claim 16 are addressed according to Misuzu Watanabe's magnetron 40 is *operable to create a magnetic field*. **a** first *electrically conductive* wall **anode or opposite** wall **electrode 46, which is secured and *grounded* through a *conductive* rod 48 to the upper cover 14, is positioned in a parallel-spaced relation to the** *second wall* **graphite target electrode 44.** As seen from Figure 1 the first *electrically conductive* wall **anode or opposite** wall **electrode 46** and the *second wall* **graphite target electrode 44** *sandwich the plasma generation region* a *in dimension of the center axis of the cylindrical metal body* 12. The *second wall* ***graphite target electrode 44*** is electrically connected to an RF power source (not shown) through the electrode box 40 and the coolant pipe 30.

In addition (DETD(5)) when the *vacuum vessel* is evacuated to a predetermined pressure, a *gas introduction means* through the gas inlet pipe 26 to produce a gaseous atmosphere at a predetermined pressure in the *vacuum vessel*. Following this, a sputtering operation is started by

applying a *second high-frequency electric* (radio frequency) power between the target and opposite electrodes *second wall* ***graphite target electrode 44*** and *first electrically conductive wall* ***anode or opposite*** *wall* ***electrode 46***. During the sputtering operation, a *plasma generation region* a indicated by an inner broken circle *established in the interior of plasma generation apparatus* (item 10, Figure 1) and between the electrodes *second wall* ***graphite target electrode 44*** and *first electrically conductive wall* ***anode or opposite*** *wall* ***electrode 46*** to release carbon atomic particles from the graphite *second wall* ***graphite target electrode 44***. The partial limitations of claim 16 are met because the *first electrically conductive wall* ***anode or opposite*** *wall* ***electrode 46*** is grounded and the graphite *second wall* ***graphite target electrode 44*** is applied a radio frequency power.

Misuzu Watanabe details a *cylindrical metal body* 12 closed at its opposite ends with upper and lower metal covers 14 and 16 to define a *vacuum vessel*, however Misuzu Watanabe does not specifically detail that the *cylindrical metal body* 12 functions as an electrode used for plasma generation.

Muneo Nakayama et al describe a method of forming silicone film using the apparatus shown in figures 1 and 2 of U.S. Pat. 4,894,254. Specifically, from DETD(91), the plasma treatment apparatus 100 has an *outer cylindrical discharge electrode* 103 fitted over a chamber member 2 *so as to enclose the plasma generation region S2 (Figure 2)* and an inner cylindrical electrode 104 disposed in the chamber member 2 in concentric relation to the *cylindrical discharge electrode 103*. The *cylindrical discharge electrode 103* is electrically connected to a *first high-frequency power supply means for applying high-frequency electric power*, and the electrode 104 is grounded. The

electrode 104 is in the form of a hollow cylinder with open upper and lower ends and has a plurality of small through holes 104a. The electrodes 103, 104 serve to generate a plasma in the apparatus 100. a person of ordinary skill in the art at the time the invention was made would consider the enhancements by Nakayama et al. to be an obvious extension over Misuzu Watanabe's *cylindrical metal body* 12. Motivation for applying a radio frequency power to Misuzu Watanabe's *cylindrical metal body* 12 stems from the desire to localize and control the plasma region geometry and density.

Conclusion

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (703) 305-1351. The examiner can normally be reached on a Monday through Friday schedule from 8am until 5pm. The official AF fax phone number for the 1763 art unit is (703) 305-3599. Any Inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (703) 308-0661.

Rudy Zervigon - RZ

March 16, 1999

Bruce Breneman
Supervisory Patent Examiner
Technology Center 1700